in the Paradox Formation; (3) the long-term performance of salt caverns in isolating the mill tailings; (4) the private/government business model that could allow use of the salt or brine, (5) the consumption of significant quantities of Colorado River water, which may be more than is available under DOE's water rights, and possibly more than what would be acceptable under the recovery program for endangered fish; (6) the high potential cost (approximately $892 million to $1.3 billion); and (7) high potential for cost growth well beyond the range identified for other alternatives.

Resolving these uncertainties sufficiently to determine whether this alternative would be technically feasible and cost-effective would require a significant investment in additional studies. Such studies would include injection well testing, subsurface characterization, salt cavern performance modeling, an assessment of legalities, and an overall system performance assessment. The studies could require several to tens of millions of dollars and many years to complete, with no guarantee that the investment would demonstrate that this alternative is technically viable or offers substantive advantages to DOE or the public relative to the other alternatives being considered. Because the available data are not sufficient to provide the basis for a decision of this magnitude, DOE would need to delay the EIS to obtain this information.

An advantage of the solution-mixed salt cavern approach is the potential for longer-term isolation and more protection than that offered by other alternatives. Other advantages are that (1) salt cavern disposal would produce the least long-term environmental impact because no surface footprint would remain at the conclusion of the disposal period, and (2) this approach provides another disposal option for contaminated ground water for 50 of the 75 to 80 years required for active ground water remediation.

However, on the basis of the evaluation of this option and review by the 12 cooperating agencies and given the technical, legal, and economic uncertainties associated with this unproven technical approach, DOE's past experience, and the potential advantages with respect to the existing alternatives and the disadvantages, DOE has concluded that this option is not "practical or feasible" and has therefore decided not to include salt cavern disposal as a reasonable alternative in the EIS.

2.6 Description and Comparison of Environmental Consequences

The following text summarizes the potential impacts (both adverse and beneficial) to the physical, biological, socioeconomic, cultural, and infrastructure environment that could occur under the on-site disposal alternative, the off-site disposal alternative, and the No Action alternative. Human health impacts are also summarized. This section also compares the major differences in impacts among the alternatives and the differences among transportation modes under the off-site disposal alternative. It is based on the consequences, including assumptions and uncertainties, identified in detail in Chapter 4.0 of the EIS.

2.6.1 Impacts Affecting the Moab Site and Vicinity Properties, Transportation Corridors, and Off-Site Disposal Locations

Geology and Soils. Under either the on-site disposal alternative or the No Action alternative, the combination of the processes of subsidence and incision would slowly affect the tailings pile by lowering it in relation to the Colorado River. This impact would not occur under the off-site

disposal alternative because the pile would be removed. There is also the potential for minor geologic instabilities in areas surrounding the White Mesa Mill site. Sand and gravel resources beneath the Moab site would be unavailable for commercial exploitation under all the alternatives due to residual contamination, even after surface and ground water remediation was complete. There are no known geologic resources beneath any of the alternative off-site disposal cell locations that would be affected by the proposed actions. Under any of the action alternatives, approximately 234,000 tons of contaminated site soil would be excavated and disposed of with the tailings.

Air Quality. Under the on-site and off-site disposal alternatives, emissions of particulate matter would occur during construction and excavation operations and would require dust control measures. Operation of vehicles and construction equipment would result in emissions of criteria air pollutants. Air pollutant emissions would be greater under the off-site disposal alternative as compared to the on-site disposal alternative, primarily because of the need to transport the tailings. Among the alternative off-site locations, transporting the tailings to the White Mesa Mill site would result in the largest volume of air pollutants because of the longer distance to be traveled. With respect to the alternative modes of transportation under the off-site disposal alternative, transportation of the tailings by slurry pipeline would involve less air pollution than would either truck or rail transportation due to the lower level of exhaust emissions. Such emissions would be about the same for truck or rail transportation. However, none of the proposed action alternatives would result in air emissions that exceed National Ambient Air Quality Standards or Prevention of Significant Deterioration increment limits.

A detailed human health analysis that includes health impacts associated with air quality is provided in Appendix D of the EIS. The design and construction of the disposal cell cover at all disposal sites would ensure that radon emissions would be below applicable health standards. Under any of the proposed action alternatives, long-term air emissions at the Moab site from technologies evaluated for active ground water remediation would not exceed health standards for workers or the public.

Ground Water. Ground water remediation would be implemented under both the on-site and off-site disposal alternatives. Under the on-site and off-site disposal alternatives, supplemental standards would be applied to protect human health. The supplemental standards would include institutional controls to prohibit the use of ground water for drinking water. Under the on-site disposal alternative, the tailings pile would be a continuing source of contamination that would maintain contaminant concentrations at levels above background concentrations in the ground water and, therefore, potentially require the application of supplemental standards (institutional controls) in perpetuity to protect human health. Under the off-site disposal alternatives, contaminant concentrations in the ground water under the Moab site would return to background levels after 150 years, by which time active ground water remediation would have been complete and supplemental standards would no longer be needed. The tailings pile would not be a continuing source of contamination to ground water under the off-site disposal alternative.

DOE estimates that meeting its target ground water remediation goal of 3 mg/L of ammonia in ground water would require active ground water remediation at the Moab site for 80 years under the on-site disposal alternative and for 75 years under the off-site disposal alternative (Figure 2–45). DOE has determined that this duration of treatment would ensure that water quality in the Colorado River would remain protective after ground water treatment was terminated.

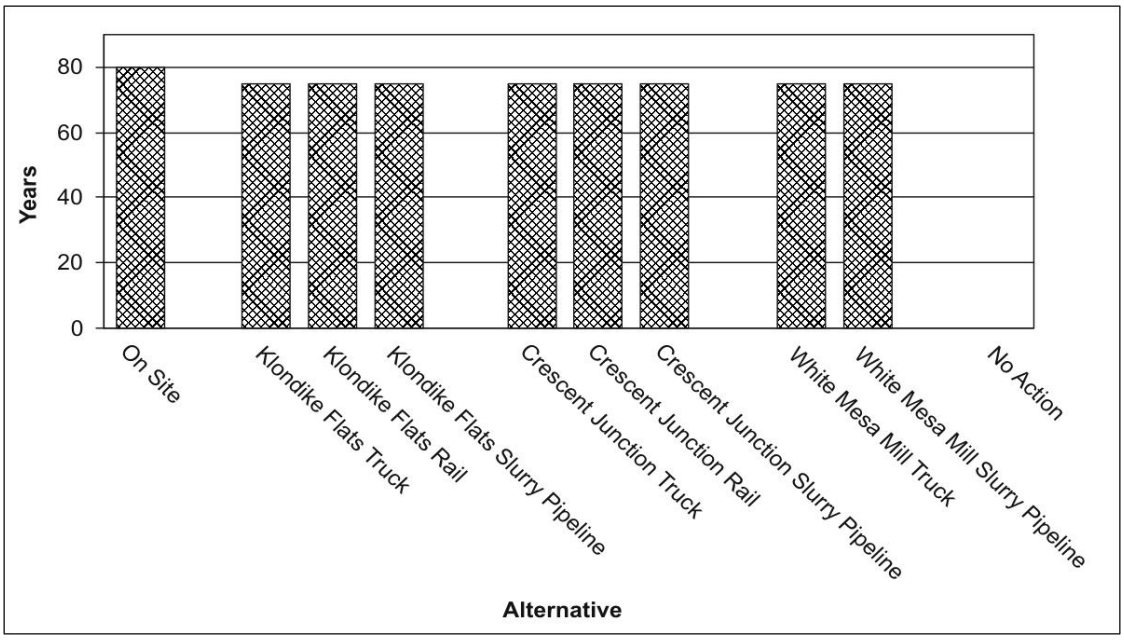


Figure 2–45. Estimated Duration of Ground Water Remediation

In the near term, DOE estimates that the proposed ground water remediation system would result in surface water quality that is protective of aquatic species in the Colorado River within 5 years after the system was implemented.

DOE also anticipates that contaminant concentrations in ground water and surface water that are protective of aquatic species in the Colorado River could be maintained, under all action alternatives, for the 200-to-1,000-year time frame specified in EPA's regulations [40 CFR 192.32(b)(1)(i)] promulgated under UMTRCA. However, under the on-site disposal and No Action alternatives, natural basin subsidence would result in permanent tailings contact with the ground water in 7,000 to 10,000 years, at which time surface water concentrations would temporarily revert to levels that are not protective of aquatic species in the Colorado River.

In addition, under the No Action alternative, the ground water beneath the Moab site would remain contaminated, would not be protective of human health, and would continue in perpetuity to discharge contaminants to the surface water at concentrations that would not be protective of aquatic species. Modeling results indicate that under the on-site disposal alternative, contaminants from the potential salt layer would reach ground water in approximately 1,100 years and would affect ground water and surface water for approximately 440 years. Because ground water treatment would have been discontinued after an estimated 80 years, surface water concentrations could revert to nonprotective levels.

Surface Water. Under the No Action alternative, ground water and surface water contamination and nonprotective river water quality would continue in perpetuity. As stated in the discussion of ground water impacts, DOE estimates that under all action alternatives, contamination of the Colorado River from ground water discharge would be reduced to levels that would be protective of aquatic species within 5 years after implementation of ground water remediation because of the interception and containment of the contaminated ground water plume. Under the off-site disposal alternative, the removal of the pile coupled with the estimated 75 years of active ground

water remediation would result in permanent protective surface water quality. Under the on-site disposal alternative, active ground water remediation would continue for an estimated 80 years.

In addition to natural subsidence described in the discussion of ground water impacts, a Colorado River 100- or 500-year flood could release additional contamination to ground water and surface water under the on-site disposal or No Action alternatives. However, under the on-site disposal alternative, the increase in ground water and river water ammonia concentrations due to floodwaters inundating the pile would be minor, and the impact on river water quality would rapidly decline over a 20-year period. Under the No Action alternative, lesser flood events could also result in the release of contaminated soils to the Colorado River as sediment runoff. In contrast to the on-site disposal and No Action alternatives, the off-site disposal alternative presents no risk of these recurrences of surface water contamination at the Moab site because the tailings pile would be removed.

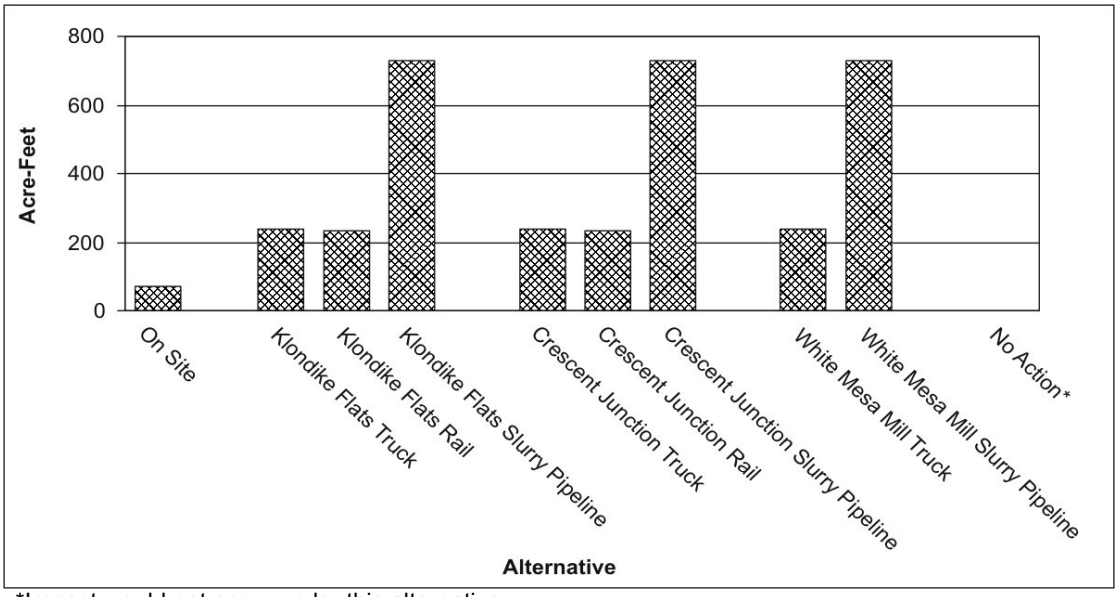
With the exception of ephemeral streams and impoundments, no surface water exists on or near any of the three off-site disposal locations.

Floodplains and Wetlands. As noted, 100- and 500-year flood events could partially inundate the disposal cell under the on-site disposal alternative or No Action alternative. In addition, less than 1 acre of wetlands could be contaminated in the long term under either of these alternatives. There are no known wetlands on or near the Klondike Flats or Crescent Junction sites, although potential wetlands exist near these sites and on the White Mesa Mill site. Under all the action alternatives, wetland areas on and adjacent to the Moab site could be adversely affected by surface remediation at the site, and for all action alternatives, activities would be necessary within the floodplain at the Moab site. Under the White Mesa Mill off-site disposal alternative, transportation of the tailings by slurry pipeline would require crossing the Colorado River, the Matheson Wetlands Preserve, and a number of perennial and intermittent streams. Potential wetlands near some borrow areas could be affected.

In accordance with its regulations (10 CFR 1022), DOE has prepared the *Floodplain and Wetlands Assessment for Remedial Action at the Moab Site*. This assessment is included in the EIS as Appendix F.

Aquatic Ecology. Under the No Action alternative, the current adverse impacts to the Colorado River and to endangered aquatic species caused by contaminated ground water would continue in perpetuity. In comparison, under either the on-site or the off-site disposal alternative, these adverse impacts would cease within 5 years of the implementation of active ground water remediation, thereby eliminating the potential for impacts to aquatic organisms for the regulatory time frame of 200 to 1,000 years. Under the on-site disposal alternative and the No Action alternative, potential future releases of contaminants from natural subsidence (see the discussion of ground water) would cause adverse impacts to aquatic species in the Colorado River, but these impacts would not occur for at least 7,000 years. Under the off-site disposal alternative, the potential for future contamination from natural subsidence would be eliminated. Under all action alternatives, surface remediation activities at the Moab site would result in temporary disturbance to approximately 1.5 miles (8,100 ft) of Colorado River shoreline.

Annual withdrawals of Colorado River water (nonpotable water) are illustrated in Figure 2–46. All of these withdrawals are within DOE's authorized water rights. In addition, under the on-site disposal alternative, the required 70-acre-foot annual withdrawal would not exceed the 100-acre-foot annual limit that the USF&WS considers to be protective of aquatic species. However, this limit would be exceeded under the off-site disposal alternative.



*Impact would not occur under this alternative.

Figure 2–46. Annual Withdrawals of Colorado River Water

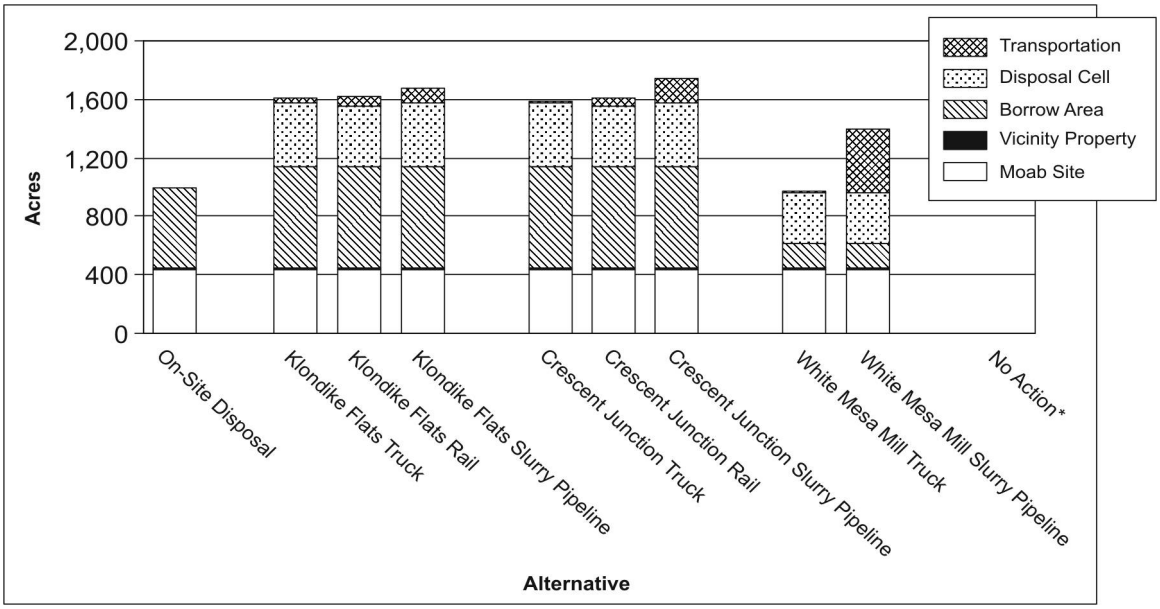
The truck or rail transportation modes would require annual withdrawals of 235 to 240 acre-feet, and the slurry pipeline mode would require annual withdrawals of up to 730 acre-feet, assuming all required slurry makeup and recycle water was drawn from the river. Exceeding the 100-acre-foot limit deemed protective for endangered fish species would be an unavoidable adverse impact. Mitigation would be accomplished in accordance with the cooperative agreement to implement the "Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin." The recovery program requires that all Section 7 consultations address water depletion impacts, and a financial contribution (adjusted annually for inflation) be paid to USF&WS to offset the impacts of water depletion. The contribution collected by USF&WS would be used to fund activities necessary to recover the endangered fish as specified in the recovery plan.

Terrestrial Ecology. All action alternatives would result in the temporary loss of 50 acres of vegetation and habitat at the Moab site. This would also be an adverse impact to some aquatic species given the proximity of the Colorado River. For any of the action alternatives, effects of human presence could reduce the overall habitat value of the area and could adversely affect two to four threatened terrestrial species if they are present at the site. Impacts of physical disturbance could be avoided or minimized by conducting site-specific investigations prior to any development to determine the presence of any species of concern.

All action alternatives would produce short-term land disturbance to the entire Moab site, to vicinity properties, and to one or more borrow areas. Disposal at any of the three off-site

locations would result in land disturbance associated with construction of the off-site disposal cell and the requisite transportation infrastructure.

In general, the vegetation that would be disturbed is sparse and provides only poor habitat for wildlife; however, under the White Mesa Mill slurry pipeline transportation option, much of the land disturbance would occur in previously undisturbed areas. Figure 2–47 depicts the total acres of disturbed land for all alternatives and the relative contribution to the total associated with five activities or facilities.



*Impact would not occur under this alternative.

Figure 2–47. Maximum Land Disturbance

Revegetation would minimize land disturbance impacts over the longer term. Under the No Action alternative, animal intrusion into the tailings pile could result in acute or chronic toxic effects to wildlife. Transportation of the tailings by truck to an off-site disposal location would result in an increase in wildlife traffic kills due to the increase in traffic.

Land Use. Under any of the disposal alternatives, the land dedicated to the disposal cell would be unavailable for any other uses in perpetuity. Under off-site disposal at the Klondike Flats and Crescent Junction locations, up to 435 acres of undisturbed BLM rangeland would be dedicated to the disposal cell and therefore would be permanently unavailable for grazing rights; although there are no known resources beneath the off-site locations, the potential for oil and gas and mineral extraction would be lost in perpetuity. Under off-site disposal at the White Mesa Mill location, up to 346 acres would be dedicated to the disposal cell and therefore would be permanently unavailable for any other uses. However, at the White Mesa Mill site, the land that would be dedicated to the disposal cell has already been committed to the disposal of radioactive material. Under the on-site disposal alternative, the entire 130-acre recontoured disposal cell would be permanently unavailable for any other uses.

Under either the on-site or any off-site disposal alternative, the land at the Moab site required for ground water remediation infrastructure would be unavailable for any other use for the 75 to 80 years needed to complete ground water remediation. If an evaporation ground water treatment

technology were implemented, the evaporation ponds could require up to 40 acres, and support facilities would require additional land.

As mentioned, under the on-site disposal alternative, the entire 130-acre recontoured disposal cell would be permanently unavailable for any other uses. Under either the on-site or the off-site disposal alternative, DOE's goal would be to have as much of the 439-acre Moab site available for unrestricted use upon completion of surface remediation as would be possible. However, it is possible that even after completion of remediation, the entire 439-acre Moab site would remain under federal control permanently. Under any action alternative, final decisions on allowable future land use at the Moab site could be made only after the success of surface and ground water remediation was determined.

Cultural Resources. Only the Moab site and White Mesa Mill site have been field-surveyed; however, cultural resources would probably be adversely affected under all the action alternatives. The numbers of potentially affected cultural resources would vary significantly among the action alternatives (Figure 2–48). The on-site disposal alternative would have the least effect on cultural resources, potentially affecting 4 to 11 sites eligible for inclusion in the National Register of Historic Places. The White Mesa Mill slurry pipeline alternative would have the greatest adverse effect on cultural resources, potentially affecting up to 121 eligible cultural sites. The Klondike Flats alternative could adversely affect a maximum of 35 to 53 eligible sites (depending upon transportation mode), and the Crescent Junction alternative could adversely affect a maximum of 11 to 36 eligible sites (depending upon transportation mode).

A minimum of 10 to 11 traditional cultural properties would be potentially affected under the White Mesa Mill truck or slurry pipeline alternatives (Figure 2–49). (The term "traditional cultural properties" can include traditional cultural practices, ceremonies, and customs.) Mitigation of the potential impacts to cultural sites and traditional cultural properties under the White Mesa Mill alternative would be extremely difficult given the density and variety of these resources, the importance attached to them by tribal members, and the number of tribal entities that would be involved in consultations.

Noise and Vibration. Noise generated by construction and operations under any of the action alternatives would not exceed 65 A-weighted decibels (dBA) at any permanent receptor location. The 65 dBA level is the City of Moab's nighttime limit for residential areas. Remediation activities at vicinity properties under any of the action alternatives would cause temporary increases in local noise levels, and the City of Moab noise standard could be violated. Small vibrations from activities at the Moab site could be felt near the boundary of Arches National Park under any of the action alternatives. Under the Klondike Flats or Crescent Junction truck alternatives, truck noise could disturb temporary residents of Arches National Park seasonal housing complex. Under the Crescent Junction truck or rail alternative, residents of Crescent Junction at the intersection of I-70 and US-191 would likely be disturbed by the noise from trucks or trains passing through to the Crescent Junction site. Under the White Mesa Mill truck alternative, residents of Moab, La Sal Junction, Monticello, and Blanding would also probably be disturbed by the increase in truck noise.

Visual Resource Contrast Rating

DOE rated the degree of contrast between natural landscapes and the proposed alternatives as follows:

None: the contrast is not visible or perceived.
Weak: the contrast can be seen but does not attract attention.
Moderate: the contrast begins to attract attention and begins to dominate the landscape.
Strong: the contrast demands attention, will not be overlooked, and is dominant in the landscape.

Visual Resources. Under the on-site disposal alternative, adverse impacts to visual resources would occur during the short and long terms. Contrasts between the surrounding natural landscape and the newly constructed disposal cell would be strong and would attract the attention of casual observers. Although these contrasts would lessen slightly over time when the side slopes become vegetated, the disposal cell would continue to remain an anomalous feature in perpetuity. Under the No Action alternative, leaving the existing tailings pile in place would result in adverse visual impacts in perpetuity as well. The predominantly smooth, horizontal lines created by the tailings pile contrast moderately and would continue to contrast moderately with the adjacent vertical sandstone cliffs. Visual impacts under both of these alternatives would not be compatible with visual objectives assigned by BLM to nearby landscapes.

Implementation of the off-site disposal alternative would result in beneficial visual impacts at the Moab site because the pile would be removed and would have negligible to adverse visual impacts at the off-site disposal locations, depending upon viewing location. Disposal at the Klondike Flats site would have mostly negligible impacts over the long term, as the cell would not be visible to most observers. Disposal at the Crescent Junction site would have mostly negligible impacts over the long term, as the cell would create only weak contrasts with the surrounding landscape for most observers (those traveling I-70). One exception would be for travelers at the I-70 scenic overlook. The higher viewing angle at this elevated location would allow observers to view the top and side slopes of the cell. The simple, rectangular form of the cell would contrast strongly with the surrounding landscape during the short term, and moderately with the surrounding landscape in the long term. Disposal at the White Mesa Mill site would have mostly negligible impacts over the long term, as the cell would not be visible to most observers. The most adverse impact to visual resources under the off-site disposal alternative would occur if the slurry pipeline transportation option were selected. The landscape scars created by the pipeline would be visible to travelers on US-191 and would create moderate contrasts in form, line, color, and texture with the surrounding landscape.

Infrastructure and Resource Requirements. Under all action alternatives, demand for electricity, potable and nonpotable water, and sewage treatment would not exceed local capacity or DOE's withdrawal rights to Colorado River water. However, under the White Mesa Mill slurry pipeline transportation option, a booster pump station on the pipeline approximately 30 miles beyond the Moab site would be required. Powering the new pump station would require (1) adding a substation transformer at the Utah Power La Sal substation, (2) installing approximately 3 miles of new distribution line to service the booster pump station, and (3) upgrading the existing line from the La Sal substation to its current endpoint in Lisbon Valley. The required upgrade would entail modifications to line and pole configurations and capacities as necessary to accommodate the increased electric load represented by the booster pump station. A slurry pipeline to White Mesa Mill would also require a new substation transformer at Utah Power's Blanding substation and upgrades to the existing distribution line from the Blanding substation to the White Mesa

Mill site. Exact upgrade requirements would be determined by the requisite detailed electrical engineering study if slurry pipeline transportation to White Mesa Mill were implemented. Total diesel fuel consumption under the on-site disposal alternative would be 4 million to 5 million gallons. Total fuel consumption under the off-site disposal alternative would range from 12 million to 20 million gallons for truck transportation, from 10 million to 11 million gallons for rail transportation, and from 7 million to 9 million gallons for slurry pipeline transportation.

Weekly generation of sanitary sewage during surface remediation activities would range from 10,000 gallons (on-site disposal alternative) to 21,000 gallons (truck transportation option).

Figure 2–50 through Figure 2–54 compare the major resource and infrastructure requirements among the alternatives. These figures show that power and nonpotable water requirements would be significantly higher for the slurry pipeline alternative than for other alternatives. Fuel requirements for the White Mesa Mill truck alternative would be noticeably greater than for other alternatives because of the greater trucking distance. Sanitary waste generation would be greater for off-site disposal (15,000 to 21,000 gallons per week) than for on-site disposal (10,000 gallons per week), reflecting the larger work force and multiple work locations.

Waste Management. All action alternatives would generate identical amounts of RRM from treatment of contaminated ground water (Figure 2–55). Assuming ground water treatment would entail an evaporation technology, DOE estimates that this waste stream would consist of approximately 6,600 tons of RRM annually for 75 to 80 years and would be disposed of in the disposal cell or at another licensed facility. Surface remediation at the Moab site would generate approximately 1,040 yd^3 of solid waste annually under all action alternatives. Under any off-site disposal alternative, another 1,040 yd^3 of solid waste would be generated annually. These solid waste streams would be disposed of in the disposal cell or in local landfills. Landfills at Moab and Blanding could accommodate this volume of solid waste.

Socioeconomics. Figure 2–56 and Figure 2–57 compare socioeconomic costs and benefits (annual cost, output of goods and services, labor earnings, and job generation) among the alternatives. Of the action alternatives, on-site disposal would be the least expensive ($20.7 million annual average), assuming an 8-year period for surface remediation. The off-site disposal alternative would average between $41.3 million (Klondike Flats site) to $52.5 million (White Mesa Mill site) annually, using truck transportation. Rail transportation to Klondike Flats or Crescent Junction would average approximately $49 million annually. Slurry pipeline transportation would average between $49.4 million (Klondike Flats site) and $58.2 million (White Mesa Mill site) annually. The annual cost of each alternative would be directly proportional to the number of jobs that would be created regionally and the annual output of goods and services for each alternative.

The largest number of new direct and indirect jobs (778) would occur during the first year only of the White Mesa Mill pipeline alternative. For all pipeline alternatives, during the first year, the labor force would be higher due to pipeline construction; during years 2 through 8, the number of new jobs would be lower. On a sustained basis (years 2 through 8), the largest number of new direct and indirect jobs, 598, would occur under the White Mesa Mill truck transportation alternative (Figure 2–57). The smallest number of new direct and indirect jobs, 171, would occur under the on-site disposal alternative. Under both the on-site and off-site disposal alternatives,

the increased work force would tend to cause some crowding-out impacts in hotels, apartments, and campgrounds in the Moab area during the peak tourism season, but lower vacancy rates would be expected during the off-season as workers took up temporary accommodation in the two-county region of influence. Crowding-out impacts would not be expected to occur in the White Mesa Mill area because of the availability of housing and accommodations.

The potential socioeconomic impacts from the No Action alternative would relate to potential longer-term damages that would result from leaving the pile and contaminated materials at vicinity properties where they are in their present form. These damages would include potential adverse impacts to human health, diminished quality of land and water resources, and potential losses in future economic development opportunities. In addition, implementation of the No Action alternative would result in loss of employment for the three to four individuals currently employed at the Moab site.

Human Health. No construction-related fatalities from industrial accidents are predicted to occur under any of the alternatives. However, construction and operations activities under all of the action alternatives would result in the exposure of workers and the public to very small amounts of radiation, which would present a risk of latent cancer fatalities among the workers and the public. Figure 2–58 shows total latent cancer fatalities for all workers by alternative and indicates the relative contribution to this impact for Moab site workers, disposal site workers, vicinity property workers, and transportation workers. The figure illustrates that latent cancer fatality risk to vicinity property and transportation workers would be very low compared to workers at the Moab site or at off-site locations. Site worker risk under the on-site disposal alternative would be less than half that under the off-site disposal alternative. Disposal at any of the three off-site locations would result in about 1 latent cancer fatality among the total worker population. The No Action alternative would result in no worker fatalities.

Figure 2–59 illustrates the latent cancer fatalities predicted for members of the public from exposure to all sources of project-related radiation except for exposure to radiation at vicinity properties, which is presented in Figure 2–60. Estimates of latent cancer fatalities shown for the action alternatives in Figure 2–59 assume public exposure during the course of remediation activities and for 30 years thereafter. Approximately 1 latent cancer fatality would occur under the off-site disposal alternative from exposure to radiation (excluding exposures to vicinity property material), and this fatality would be almost entirely associated with exposure to radiation from remediation activities at the Moab site as opposed to off-site locations (Figure 2–59). Among the three transportation modes, the slurry pipeline mode represents the lowest public risk (0.75 latent cancer fatality) compared to 1.0 latent cancer fatality for truck or rail transportation. In contrast, the on-site disposal alternative represents a risk of about one-quarter of a latent cancer fatality among the public, and the No Action alternative represents just over 5 latent cancer fatalities among the public over a 30-year time period.

Figure 2–60 illustrates the potential latent cancer fatalities among members of the public due to exposure to radiation at vicinity properties based on the conservative assumptions used for analyses. For the action alternatives, this figure shows the relative contribution to the aggregate risk for 5 years before and for 30 years after remediation. DOE estimates that there would potentially be 12 latent cancer fatalities among the public under any action alternative and 26 latent cancer fatalities if the No Action alternative were implemented. These risks reflect ongoing long-term exposure dating back to the beginning of mill operations.

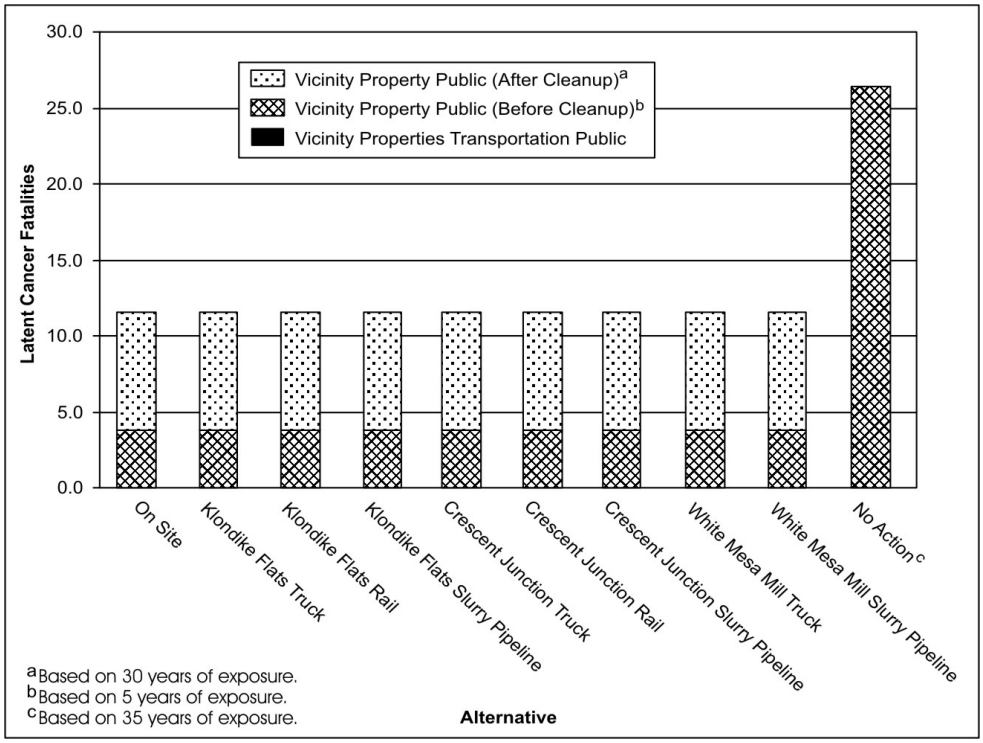


Figure 2–60. Public Latent Cancer Fatalities from Vicinity Property Exposure

The design life of the disposal cell for the uranium mill tailings is 200 to 1,000 years. Over this period of time, the amount of radioactivity in the disposal cell will decrease slightly, less than 1 percent, due to the decay of the radionuclides in the uranium mill tailings. In the time frame of 200 to 1,000 years, the major route of exposure of people would be through the inhalation of radon progeny from the disposal cell. Even though DOE's experience supports a conclusion that radon release rates from the capped pile would be negligible, and DOE's long-term monitoring and maintenance of the site would ensure cap integrity, for the purpose of supporting analyses of long-term performance and impacts, DOE has also assessed impacts assuming the maximum allowable release rate of radon, 20 picocuries per square meter per second (pCi/m^2-s), under EPA's regulations (40 CFR 192).

On the basis of this emission rate, after the disposal cell cover was installed the annual latent cancer fatality risk from radon for a nearby resident at any of the disposal sites is estimated to be 8.9×10^{-5} per year of exposure. As with the radioactivity in the disposal cell, the annual risk would also not decrease appreciably over the 200- to 1,000-year time. Therefore, the annual latent cancer fatality risk for a nearby resident would be about the same immediately after the cover was installed as it would be 1,000 years after the cover was installed.

Long-term population risk assessment for this 1,000-year period would be greatly influenced by changing demographics. For comparison among the on-site and off-site alternatives, assuming no changes in population numbers or geographic distribution yields the following population risks over 1,000 years: the population around the Moab site would incur 6 latent cancer fatalities; the population around the Klondike Flats site would have a latent cancer fatality risk of 0.09; the

population around the Crescent Junction site would have a latent cancer fatality risk of 0.07; and the population around the White Mesa Mill site would have a latent cancer fatality risk of 0.1.

Release of uranium mill tailings in a truck or rail transportation accident would not be expected to result in any latent cancer fatalities to either the exposed population or the maximally exposed individual.

Figure 2–61 compares nonradiological fatalities predicted among members of the public due to project-related traffic accidents and to exposure to project-related nonradiological pollutants during surface remediation activities. There would be less than one-tenth of one fatality due to exposure to nonradiological pollutants (for example, exhaust emissions) under any action alternative (Figure 2–61). Traffic fatalities would be directly proportional to truck shipment miles; fewer than one traffic fatality is predicted to occur under any action alternative except the White Mesa Mill truck alternative, where 1.3 traffic fatalities are predicted.

Traffic. Figure 2–62 through Figure 2–64 depict traffic impacts among the alternatives. All the proposed action alternatives would result in increased traffic on local roads and US-191. Among the three off-site disposal locations, truck transportation to the White Mesa Mill site would represent the most severe impact to traffic in central Moab, an area that UDOT currently considers to be highly congested. Transportation of contaminated materials from the Moab site to the White Mesa Mill site would result in a 127-percent increase in average annual daily truck traffic through Moab. In contrast, if the tailings were trucked to the Klondike Flats or Crescent Junction sites, or if either the rail or slurry pipeline transportation modes were implemented for any of the off-site disposal locations, there would be only a 7-percent increase in truck traffic through central Moab from shipments of vicinity property materials under all action alternatives, and only a 2- to 3-percent increase from shipments of borrow materials for the on-site disposal alternative or for off-site disposal at the Klondike Flats or Crescent Junction locations. All alternatives would also result in an overall increase in the average annual daily truck traffic on US-191, both north and south of Moab, from shipments of contaminated materials and borrow materials. These impacts would be most severe with the off-site truck transportation mode, which would increase average annual daily truck traffic on US-191 by 95 percent for the Klondike Flats or the Crescent Junction alternative and by 65 to 186 percent for the White Mesa Mill alternative, depending on the segment of US-191.

In comparison, the on-site disposal alternative and the rail or pipeline off-site alternatives would increase average annual daily truck traffic on US-191 only by 7 percent. Assuming conservatively that each worker would commute through Moab, the increase in all traffic through central Moab due to commuting workers would be minor for all alternatives, ranging from a 1- to 5-percent increase. As shown in Figure 2–61, DOE estimates that less than one traffic fatality would occur for all alternatives and transportation modes with the exception of truck transportation to White Mesa Mill, for which modeling predicts that 1.3 traffic fatalities would occur.

Environmental Justice. Disproportionately high and adverse impacts to minority and low-income populations would occur under the White Mesa Mill off-site disposal alternative (truck or slurry pipeline transportation) as a result of unavoidable adverse impacts to at least 10 to 11 potential traditional cultural properties located on and near the White Mesa Mill site, the proposed White Mesa Mill pipeline route, the White Mesa Mill borrow area, and the Blanding borrow area. Moreover, if the White Mesa Mill alternative were implemented, it is likely that additional traditional cultural properties would be located and identified during cultural studies. DOE would address the potential for adverse impacts to these properties once they were discovered.

The sacred, religious, and ceremonial sites already identified as traditional cultural properties are associated with the Ute, Navajo, and Hopi cultures and people. Currently, there are no known traditional cultural properties at any other site, although the potential for their being identified during cultural studies and consultations ranges from low to high, depending on the site and mode of transportation. The impacts to all other resource areas analyzed in the EIS (for example, transportation or human health) would not represent a disproportionate adverse impact to minority and low-income populations under any alternative.

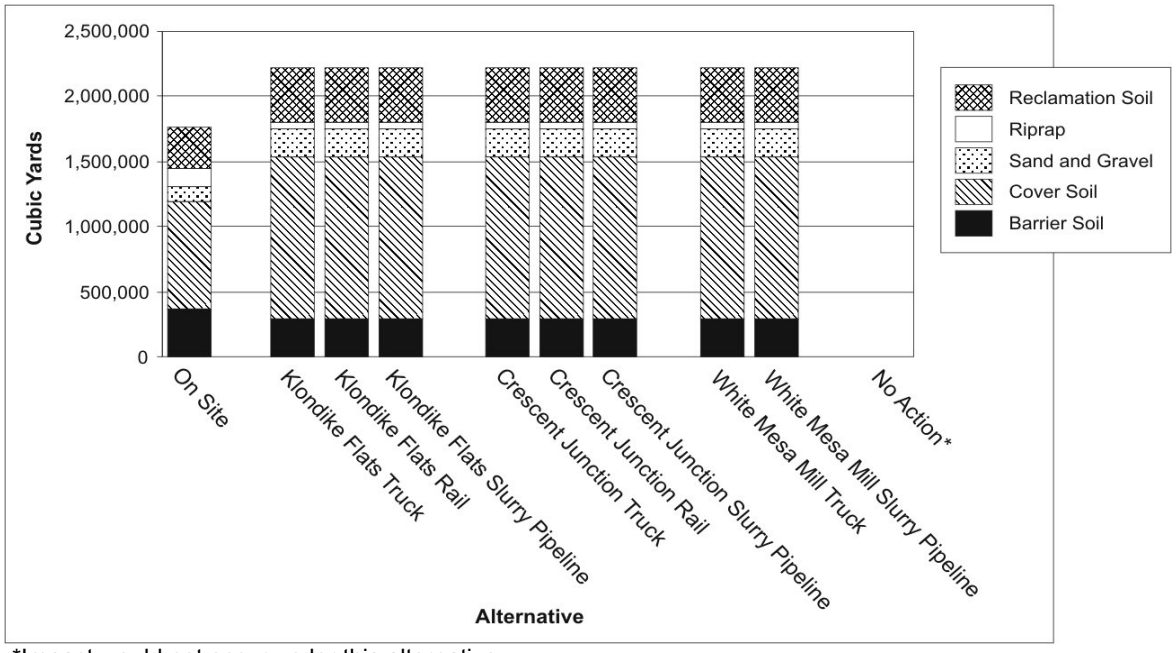
Disposal Cell or Tailings Pile Failure. Under the on-site remediation alternative and No Action alternative, a disposal cell or tailings pile failure could pose a risk under the residential scenario and could result in adverse impacts to aquatic receptors from uranium and ammonia concentrations in the Colorado River. The risk would be much lower for the off-site disposal locations because the sites are not located near a river, do not have historical seismic activity, are not prone to subsidence attributed to salt dissolution below the alluvial basin, and are located away from population centers and sensitive habitats. The possibility and consequences of a tailings pile failure are greatest under the No Action alternative because it would not include the use of engineering controls to mitigate impacts from floods and other natural events as would occur under the on-site disposal alternative.

Table 2–32 compares the impacts analyzed in the EIS. In general, the information in Table 2–32 is the same as that provided in this section. The information is repeated in tabular form as an aid to readers who may wish to rapidly compare a specific impact across all alternatives.

2.6.2 Impacts Affecting Potential Borrow Areas

Impacts to borrow areas would occur under any of the alternative actions. However, impacts at borrow areas are discussed in this section as a separate, stand-alone topic in response to a request by BLM, one of the cooperating agencies. BLM indicated that analyzing impacts to borrow areas as a stand-alone topic would facilitate the subsequent analyses necessary to authorize DOE to use borrow material at BLM-managed borrow areas.

All of the off-site disposal locations would require approximately the same amount of borrow material (2.2 million yd^3), about 20 percent more than the 1.8 million yd^3 that would be needed for the on-site alternative (Figure 2–65). The relative amounts of the five types of borrow material would be very similar for all alternatives, and approximately 90 percent of the required borrow material would be excavated soil (Figure 2–65). Further description of impacts at anticipated borrow areas is provided in Section 4.5 and Table 4-52. These impacts are discussed as a stand-alone topic in response to a request by BLM.



*Impact would not occur under this alternative.

Figure 2–65. Borrow Material Requirements

2.6.3 Consequences of Uncertainty

The purpose of this EIS is to assess and compare the potential environmental impacts associated with reasonable alternative actions to remediate the uranium mill tailings pile at Moab and contaminated ground water beneath the site. The EIS describes these impacts as accurately as possible given the available data and certain assumptions as required under the Council on Environmental Quality's NEPA regulations (40 CFR 1502.22). However, DOE recognizes that uncertainties are associated with these assumptions and that some of the assumptions could turn out to be inaccurate. Other areas of uncertainty have developed between DOE and one or more of its cooperating agencies on issues regarding regulatory or scientific interpretation. These uncertainties are relevant to decision-making, because if any of the assumptions underlying the EIS change significantly, the impacts as described could also change. It is important that decision-makers are cognizant not only of the nature and range of uncertainties inherent in the EIS but also of the potential consequences of these uncertainties. Many of the uncertainties have been identified and acknowledged in the EIS. This section delineates the major uncertainties and, to the extent possible, describes the potential consequences of them.

The uncertainties in the EIS include areas as diverse as the future regulatory environment, the duration of worker exposure to radiation, ground water modeling assumptions, and the timing of congressional appropriations. Some of these uncertainties (for example, congressional appropriations) would be "alternative neutral" in that the consequence of the uncertainty would be expected to affect all alternatives in the same way and to the same degree, with the exception of the No Action alternative. Other uncertainties would be irrelevant to some alternatives but of significant potential consequence to others. For example, the uncertainties surrounding the speed and direction of river migration are relevant to the on-site or No Action alternatives but are of no consequence to the off-site disposal alternative because the pile would have been removed.

The majority of these uncertainties relate to the intrinsic variability and heterogeneity of the natural media to which DOE is applying engineering solutions. The types and degrees of uncertainty identified in this section are typical of those that have been encountered during the characterization and remediation of the previous 22 sites designated under Title I of UMTRCA and are similarly typical of the uncertainties associated with this stage of decision-making for remedial action projects. Based on DOE's extensive history with the remediation of uranium mill tailings sites, reasonable conservatism has been employed in characterizing the costs, resources, and impacts associated with meeting the statutory requirements of UMTRCA and NEPA. Consistent with the Council on Environmental Quality requirements for incomplete or unavailable information (40 CFR 1502.22), within this EIS DOE has explicitly identified its assumptions where information may be limited, clearly indicated the methods and models used in its analyses, and evaluated the potential relevance of incomplete or unavailable information to decision-making.

With the exception of ground water modeling, should DOE's characterization, assessment, or assumptions prove incorrect, the resultant changes in impacts would not be of a significance that would affect the principal reclamation decision of whether to relocate the tailings from their current location. Ground water modeling is an inherently subjective science that combines scientific facts with scientific observations and expert assumptions to develop a comprehensive image of a natural system, which in the case of the Moab site has been perturbed by human activities. To support the modeling effort, DOE has acquired a level of data for the Moab site consistent with its approach at the previous 22 UMTRCA sites that DOE has remediated. Additional long-term ground water and surface water sampling and analysis could be conducted and used to refine the computer model predictions and reduce uncertainties. However, further narrowing the model uncertainties by incorporating additional monitoring results would require perhaps as much as half of the predicted 75- to 80-year remediation period to validate the performance of the model (Bredehoeft 2003).

Table 2–33 identifies the major areas of uncertainty, characterizes the changes that might occur in the predicted impacts, and establishes the relative effect that such changes in impacts might have on the alternatives evaluated in this EIS.

2.7 Other Decision-Making Factors

2.7.1 Areas of Controversy

Several areas of continuing controversy have emerged as a result of DOE's discussions and consultations with cooperating and other agencies or as a result of public comments. Some of these issues and controversies derive directly from technical or regulatory uncertainties. Other nontechnical issues and controversies have their origins in policies, perspectives, or positions endorsed by specific agencies or members of the public. For example, while DOE has not yet identified a preferred alternative, several cooperating agencies have expressed preferences.

One area of controversy involves the ground water remediation standard to be applied. Based on its calculations, DOE has determined that protection for aquatic species would be achieved at total ammonia concentrations in surface water of 3 mg/L (acute criteria) and 0.6 mg/L (chronic criteria that assumes dilution within a mixing zone). The USF&WS agrees with DOE that the target goals DOE has selected would be protective of aquatic species in the Colorado River.